Radiographic features in 1016 adults admitted to hospital with acute asthma

C.M. PICKUP, P.A. NEE & P.E. RANDALL

North Manchester General Hospital, Delaunays Road, Crumpsall, Manchester

SUMMARY
A retrospective review was carried out of the radiographic features of 1016 adults admitted to hospital with acute asthma over a 4-year time period.

The radiographic features were classified into five groups: (I) normal, 536 patients (52.9%); (II) features compatible with obstructive lung disease, 323 patients (31.8%); (III) complications of asthma including infection, segmental or greater atelectasis, one case of pneumomediastinum and one case of pneumothorax, 83 patients (8.2%); (IV) unimportant incidental findings, six cases (0.6%); and (V) important incidental findings including tuberculosis, heart failure, and bronchial neoplasm, 68 cases (6.7%).

We conclude that in this large series of patients presenting with asthma symptoms severe enough to merit admission there is an incidence of clinically significant radiographic abnormalities of approximately 15%. Admission chest radiography is therefore indicated in adults who are hospitalized with acute asthma.

Key words: adult in-patients, asthma, asthma radiography, chest radiography

INTRODUCTION
The majority of patients admitted to hospital with symptoms of acute asthma undergo a chest radiograph on admission. Routine admission chest radiography is aimed at identifying the important complications of asthma such as pneumothorax, pneumomediastinum and atelectasis as well as identifying treatable associated conditions such as pneumonia and heart failure. It is also necessary to rule out pulmonary tuberculosis before initiating steroid therapy.

Previous studies have reported a substantial yield of abnormalities on the admission chest radiographs of asthmatic patients.\(^1\)\(^2\) However, others have suggested that it is unusual to find abnormalities that are likely to influence treatment in otherwise uncomplicated cases admitted with dyspnoea and wheeze.\(^3\)\(^4\)

It is clearly undesirable to irradiate a patient unnecessarily and to expend financial and time resources on an investigation with a poor return in detecting clinically significant lesions. To date there has been no large scale United Kingdom based survey of the radiographic findings in patients hospitalized with acute asthma.

SUBJECTS AND METHODS
We carried out a retrospective review of the radiographic features of all patients discharged from an inner-city district general hospital with a diagnosis compatible with acute asthma (International Classification of Disease Codes 493.0, 493.1 and 493.9) between the 1 April, 1989 and 31 March, 1993. The names and district numbers of all these patients were accessed by means of a computerized search of the Patient Administration System. These data were then input into the Kodak Radiological Information System and the radiologist’s report was obtained for the admission chest radiograph relating to each episode.

Radiographs were ordered by junior doctors in the specialties of accident and emergency (A&E) or general medicine. Widely publicized guidelines on the management of acute severe asthma in adults\(^5\) and the utility of radiographs\(^6\) were available for most of the study period.

The radiographs were reported by a radiological staff of six consultants, three senior registrars and six registrars.

RESULTS
In this 4-year time period 1218 patients were discharged (or died) with a diagnosis of asthma. Admission radiographs were performed in 1016
patients (384 males). Children are not admitted to this hospital, the age range of all patients was 16–94 years. Some patients were admitted more than once and some had more than one feature on their radiograph. For the purposes of this study multiple admissions were regarded as separate episodes.

Radiological findings were classified into the following five groups.

(I) Normal. Five hundred and thirty-six radiographs (52.9%) revealed no abnormal signs.

(II) Features compatible with a diagnosis of uncomplicated obstructive lung disease. There were 323 cases (31.8%) in this group. Patients were included in this group if the radiograph contained features such as hyperinflation, increased lung markings or a combination of the two.

(III) Important complications. There were 83 patients (8.2%) in this group including 68 with radiographic evidence of pulmonary infection or consolidation and 13 with atelectasis of segmental or greater extent. There was just one case of pneumothorax, a 43-year-old female, and one case of pneumomediastinum, a 17-year-old male.

(IV) Unimportant incidental findings. There were six patients (0.6%) in this group. Radiographic features were two cases each of fibrosis and old fractured ribs and one case each of pulmonary hypoplasia and previous pneumonectomy.

(V) Important incidental features. Sixty-eight patients (6.7%) had radiographic findings consistent with an alternative diagnosis for their presenting symptoms. Radiographic findings included evidence of heart failure (cardiomegaly, pulmonary oedema or pleural effusion), pulmonary tuberculosis and bronchogenic carcinoma.

The incidence of the various radiological features are summarized in Table 1.

Groups (III) and (V) were regarded as including the radiological features that would have a direct bearing on the clinical management of the patients. When added together they account for 151 radiographs, approximately 15% of the total. There was no significant difference in age or sex distribution between these groups and the rest of the population.

<table>
<thead>
<tr>
<th>Group</th>
<th>Finding</th>
<th>Incidence</th>
<th>Column (%)</th>
<th>Row Mean age (range)</th>
<th>Males</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Normal</td>
<td>536</td>
<td>52.7</td>
<td>35</td>
<td>45.5</td>
<td>(16–87)</td>
</tr>
<tr>
<td>II</td>
<td>(a) Hyperaeration (HA)</td>
<td>184</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Increased lung markings/subsegmental atelectasis (ILM/SSA)</td>
<td>57</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) HA + ILM/SSA</td>
<td>82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>323</td>
<td>31.8</td>
<td>39</td>
<td>61.1</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>(a) Pulmonary infection/ consolidation</td>
<td>68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Segmental atelectasis</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) Pneumothorax</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d) Pneumomediastinum</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>83</td>
<td>8.2</td>
<td>41</td>
<td>43.9</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>(a) Pulmonary fibrosis</td>
<td>2</td>
<td></td>
<td></td>
<td>2 (21–80)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Hypoplasia</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) Pneumonectomy</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d) Old fractured ribs</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>6</td>
<td>0.6</td>
<td>50</td>
<td>42.5</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>(a) Cardiac failure</td>
<td>57</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Pulmonary tuberculosis</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) Carcinoma</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>68</td>
<td>6.7</td>
<td>34</td>
<td>63.6</td>
<td>(22–94)</td>
</tr>
</tbody>
</table>

Table 1. Findings in 1016 admission chest radiographs in adults admitted to hospital with acute asthma.
DISCUSSION

It is routine practice to obtain a radiograph of the chest in patients admitted to hospital with severe obstructive lung disease including asthma. Chest radiographs comprise approximately 33% of all exposures in UK practice. Most of these radiographs are normal or show features consistent with uncomplicated chronic obstructive lung disease. The radiological features most frequently observed are hyperinflation, increased lung markings, peribronchial thickening, and subsegmental atelectasis. Some authorities believe that routine chest radiography is indicated to rule out important complications like pneumonia and pneumothorax and associated conditions which may mimic acute bronchospasm such as heart failure and, especially in children, inhaled foreign body. It is also essential to exclude potential complications of assisted ventilation especially pneumothorax and any contra-indications to the commencement of steroids therapy such as evidence of pulmonary tuberculosis.

The frequency of radiological abnormalities on routine chest radiographs in adult asthmatics has been shown to be as low as 2.2%. It has therefore been suggested that many patients could be spared the time, the expense and the radiation of multiple exposures which rarely contribute to clinical management decisions.

A selective approach is recommended for patients presenting to the A&E department whereby radiographs are ordered depending upon clinical criteria such as acute deterioration, failure to respond to therapy or a history of immunosuppression. Guidelines produced by the British Thoracic Society and others recommend chest radiography to exclude pneumothorax in patients with severe acute asthma.

Patients admitted to in-patient beds represent the more severe end of the spectrum and it is usual for them to have a chest radiograph performed prior to admission.

There have been few studies of the frequency of radiographic abnormalities in adult patients admitted to hospital with exacerbations of obstructive lung disease. One group looked at 242 admission chest radiographs and another a total of 125 radiographs. The only UK based study that we know of examined the radiographic findings in 135 adults and children seen in an A&E department. The range of significant radiographic abnormalities in these three studies was 10.4–14.8%.

The present study represents the largest ever examination of radiological findings in adult patients admitted to hospital with exacerbations of asthmatic symptoms. The diagnosis of asthma was ascribed to these patients by the senior physician in charge of the case. Many patients would therefore have acquired a clinical coding compatible with a diagnosis of asthma when there was an element of reversible bronchospasm, regardless of the presence of chronic obstructive lung disease. The occurrence of abnormalities likely to lead to a change in the clinical management of the patient the percentage incidence is 14.8%, which relates closely to the findings of others.

We have not attempted to correlate clinical findings with radiological features. Others have made this correlation in smaller studies on the basis of the history, the physical signs and the results of special tests. They have shown that application of exclusion criteria can reduce admission radiographic exposures by around 50%. Others, however, have pointed to the difficulty in diagnosing the presence of pneumonia on a clinical basis. The use of antibiotics is significantly affected by the demonstration of focal pulmonary opacities even in the absence of physical signs of pneumonia.

Pneumothorax is a dangerous complication of asthma which is frequently clinically silent until the patient suffers a catastrophic deterioration. The incidence of pneumothorax or pneumomediastinum in the present study (0.2%) is similar to the 0.15% incidence reported by Burke. There was a relatively high frequency of other conditions likely to affect management in the present series. Atelectasis for example, at the segmental or greater level particularity influences the physiotherapy regime. Heart failure will determine the prescription of diuretic therapy and a chest film compatible with pulmonary tuberculosis will prompt a search for activity of the disease as well as a cautious approach to the prescription of oral steroids.

Our study may be criticized on the grounds that it is a retrospective review of patients by discharge diagnosis of asthma. It is theoretically possible, therefore, that some patients may have been coded under another diagnosis. For example an asthmatic presenting with wheeze and dyspnoea complicated by pulmonary infection may be coded as pneumonia. This is unlikely to affect our findings seriously because of the large number of episodes we captured using the present methodology. In general most asthmatic patients presenting to A&E departments do receive codes consistent with a primary diagnosis of asthma. In one review of 6000 emerg-
ency department visits no example of the occurrence of inappropriate discharge diagnosis was found.  

We are unable to report which particular radiographic technique was used to obtain the chest films in all cases. However, practical experience teaches us that the majority of these films will be single view anteroposterior films taken portably within the resuscitation area. This introduces another potential bias in our study. In a previous study the yield of major abnormalities was 34% when adult asthma patients received a standard erect posteroanterior and left lateral film.  

If anything then, our finding of major abnormalities in 14.8% is an under-representation.

In conclusion, this large scale review of radiographic findings on the admission radiographs of adult patients admitted to hospital with asthma has revealed an incidence of major abnormalities likely to affect treatment of 14.8% of patients. Complications of asthma, such as segmental or greater atelectasis and important associated conditions such as pneumonia and heart-failure occurred relatively frequently. Pneumothorax and pneumomediastinum, even in patients with symptoms severe enough to cause their admission to hospital, occur rarely.

ACKNOWLEDGEMENTS

The authors are grateful to Mrs Gill Dewey and her staff in the Medical Audit Department and to the Medical Records Staff at the North Manchester General Hospital. We are also grateful to Mrs Olive Tracey for typing the manuscript.

REFERENCES


